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PRACTICAL WIRELESS

JUNE
1977

40p

The NEW
Pw TELE~

TENNIS
FOOTBALL
SQUASH
PELOTA

plus

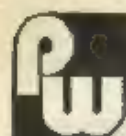
ON-SCREEN
SCORING

&

SOUND
EFFECTS



also: CW FILTER UNIT
VERSATILE AF GENERATOR



TELE~

plus:-

ON-SCREEN SCORING & SOUND EFFECTS

TENNIS FOOTBALL SQUASH PELOTA

THE General Instruments AY-3-8500 television games integrated circuit allows a complex multigame unit to be built using very few additional components. The single device provides for 4 ball games and 2 shooting games. This article will describe a unit for the 4 ball games.

THE AY-3-8500

Before describing the construction of the unit it will be useful to give a description of the special IC. The device is in a standard 28 pin dual-in-line package with pins 1, 14, 15 and 28 not being used. Pins 2 and 4 are ground and plus 8V respectively.

★ components list

Resistors

R1	47kΩ
R2	1kΩ
R3	10kΩ
R4	2-2kΩ
R5	220Ω
R6	220Ω
R7	47kΩ
R8	1kΩ
R9	47kΩ
R10	47kΩ
R11	47kΩ
R12	47kΩ
R13	33kΩ
R14	47kΩ
R15	1kΩ
R16	6-8kΩ
R17	4-7kΩ
R18	1kΩ
R19	100Ω
R20	100Ω
VR1	10kΩ standard horizontal preset
VR2	10kΩ standard horizontal preset
VR3	1kΩ standard horizontal preset
VR4	100kΩ linear
VR5	100kΩ linear

All fixed resistors are 1/4W, 5%

Capacitors

C1	2200μF, 25V
C2	0-22μF
C3	0-22μF
C4	1000pF polystyrene
C5	1000pF polystyrene
C6	100pF polystyrene

Miscellaneous

T1, mains transformer, 2 secondaries each 0-12V at 250mA, fixing centres 53-5mm. FS1, fuse holder, chassis mounting, 20mm and 200mA fuse. PCB from Readers PCB Service. Speaker, miniature, 40Ω. Former 4mm with dust core. Wire 40SWG enamel covered, 1metre long. Wire 22SWG, tinned copper, 250mm long. Case sloping top, 216mm x 130mm x 47mm (front) x 79mm (back), Watford code NJSF2 Doram code 509-508. Boxes, 2 off, 85mm x 58mm x 37mm, Watford code NJHC1 Doram code 509-536. (Note, these cases provide an attractive cover but any case of similar size can be used). SKT1, coax socket. Coax cable and 2 coax plugs. 2 grommets. Mains cable. Board pins. DIL socket (see text). Heat sink for IC2

C7	100pF polystyrene
C8	0-22μF
C9	0-22μF
C10	10μF, 10V
C11	1000pF disc ceramic
C12	10pF plate ceramic
C13	3-3pF plate ceramic
C14	22pF plate ceramic
C15	5-6pF plate ceramic
C16	1000pF disc ceramic, 250V
C17	1000pF disc ceramic, 250V
C18	47μF, 10V tantalum

Switches

S1	1 pole 8 way rotary.
S2	Single pole, biased off, miniature push
S3	S.P.S.T. miniature toggle.
S4	S.P.S.T. miniature toggle
S5	S.P.S.T. miniature toggle
S6	S.P.S.T. miniature toggle
S7	D.P.S.T. miniature toggle, mains rated

Semiconductors

Tr1	BC108
Tr2	BC108
Tr3	BC108
Tr4	BC108
Tr5	BSX20
D1	1N4001
D2	1N4001
D3	1N914
D4	1N914
IC1	AY-3-8500 G.I.
IC2	MC7808 or 78L82AWC

D.S. COUTTS



Fig. 1. The outlines of the four games that can be played using this unit. The size of the individual dots may not be as shown due to tube distortion and sharpness of focus.

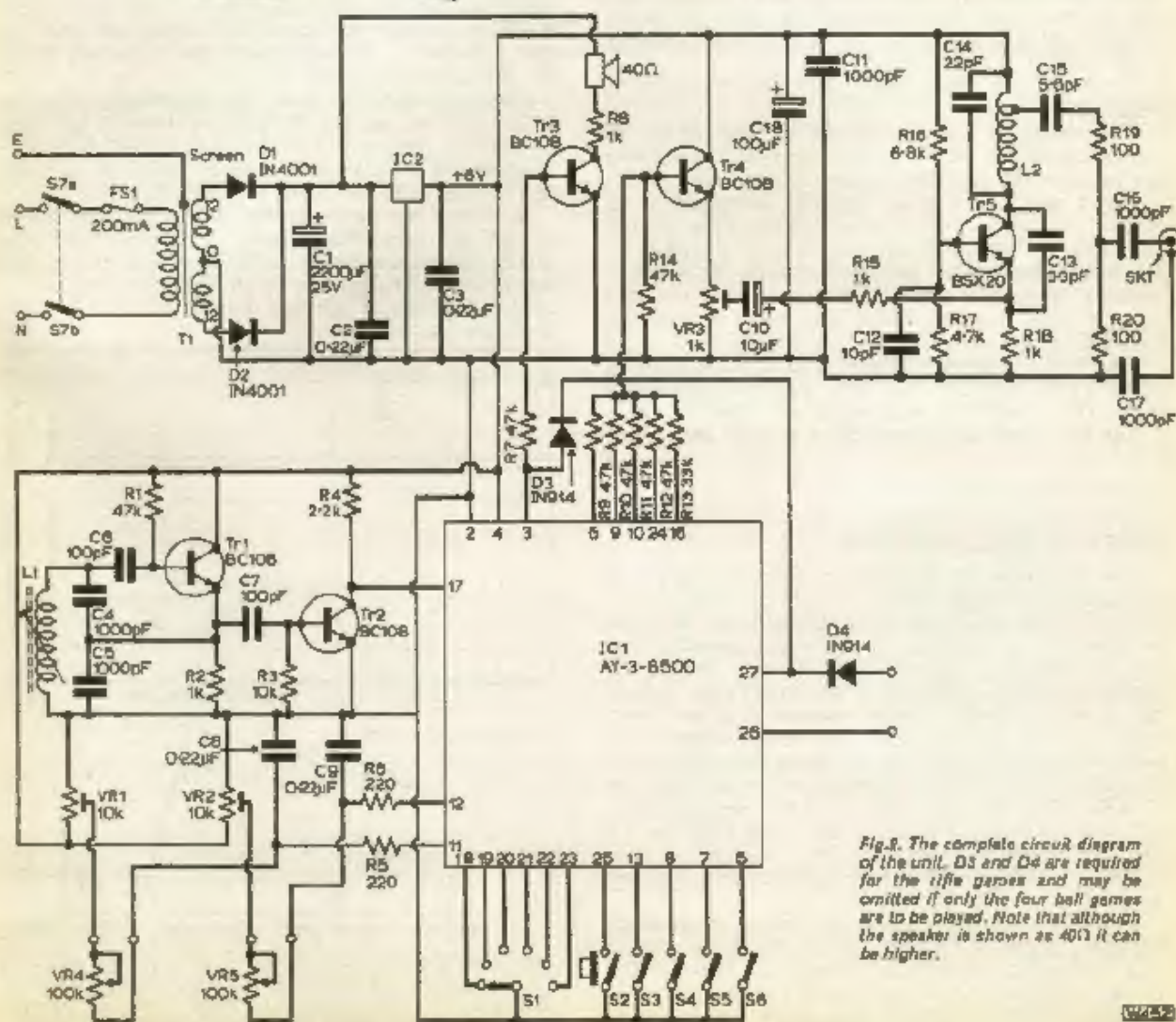


Fig. 2. The complete circuit diagram of the unit. D3 and D4 are required for the rifle games and may be omitted if only the four ball games are to be played. Note that although the speaker is shown as 40Ω it can be higher.

Pin 3 gives an output of 500Hz, 1kHz or 2kHz which corresponds to the ball hitting the line, the ball hitting the bat and a scoring signal.

The ball will bounce off the correct bat at an angle determined by the condition of pin 5. When it is left open circuit the angle is constant over the whole bat except that the reflection is 'up' in the upper section of the bat and 'down' in the lower section. When pin 5 is connected to ground the bat is divided into four vertical sections. The angles in the centre two sections are as before but the outer two reflections are at steeper angles.

Pin 7 controls the ball speed. If left open circuit the ball travels slowly (suitable for beginners) if connected to ground the ball speeds up.

Automatic or manual service is selected by pin 8. If the ball leaves the court when pin 8 is open circuit it will remain off until the pin is grounded momentarily. If pin 8 is left switched to ground the ball will serve automatically, travelling in the direction that it left the ground (ie. if the right hand player scores then the ball will be served from the right hand side).

Pin 11 is the right player input and an R/C network on this pin controls the vertical position of the right bat or, in football, both right bats. Pin 12 provides similar control for the left hand player. The size of the bats is controlled by pin 13. When switched to ground the bat size is half that resulting from leaving it open circuit.

Pin 17 is the clock input and a 2MHz signal is required.

The choice of games is made by pins 18 to 23, depending which of them is grounded. The display for each of the four ball games is given in Fig. 1.

Pin 2 provides a reset facility. Switching it to ground resets the score to zero and when the ground connection is removed the ball will be served from the left. When either player scores 15 the game is finished. Both bats become transparent to the ball and the score remains static. The game is restarted by pushing and releasing the reset button.

Pins 6, 9, 10, 16 and 24 are outputs corresponding to ball, right bat, left bat, sync and field/score outputs. Their functions are explained later.

The two shooting games utilise pins 26 and 27.

CIRCUIT DESCRIPTION

The complete circuit diagram of the unit is given as Fig. 2.

The secondary of the mains transformer is given as 12-0-12V. In fact, the transformer specified has two secondaries, each of 12V. These need to be wired in series (ie, the 0V of the first to the 12V of the second) and the ground connected to the junction. D1 and D2 provide full wave rectification, smoothing is by C1 and the resultant DC is regulated by IC2. High frequency decoupling is provided by C2 and C3 on the input and output of the regulator. C11 and C18 give additional decoupling to the 8V rail.

Tr1 is a 2MHz oscillator, its output being buffered by Tr2 before being fed to IC1.

VR1, VR4, R5 and C8 are the timing components for the right hand player. VR4 is the hand control and changes the charging current of C8 thus moving the vertical position of the bat. VR1 sets the voltage towards which C8 charges and alters the sweep of

the bat. R5 limits the current during the discharge period at frame flyback. The corresponding controls for the left hand player are VR2, VR5, R6 and C9.

Tr3 drives the speaker, with R8 limiting the volume. If greater volume is required the value of R8 can be reduced but, on the prototypes, it was sufficient for most domestic uses.

The video and sync outputs are summed by R9 to R13 and drive Tr4, an emitter follower. VR3 in the emitter allows the modulation level of Tr5 to be adjusted.

Tr5 is VHF oscillator operating at about 170MHz with harmonics extending into the UHF band. The output is divided by R19 and R20 and the unit is DC isolated from the display monitor by C16 and C17.

Switches S1 to S6 control the games and functions already described, (see Fig. 7 for details also).

CONSTRUCTION

Before commencing construction of the electronics it is necessary to drill the mounting holes in the case. The board can be used as a template to ensure they are in the right position. The board will ultimately sit with the modulator section at the front right and with its right hand edge about 10mm from the right side of the case. This allows the leads of C16 and C17 to be kept short. The mounting holes for the board are 6 BA.

Having drilled the base, the remaining holes can be marked out as Fig. 3. These holes will be sized to suit the grommets and the coax socket. It is also advisable to drill a series of 5mm holes in the base and in the back to assist ventilation.

Mark the top panel as Fig. 4 and drill the holes to suit the components used. A suitable hole size for the speaker is 20mm. Label the panel and mount the switches. The speaker is glued to the panel using a rapid-cure epoxy but first glue a piece of speaker fret over the hole.

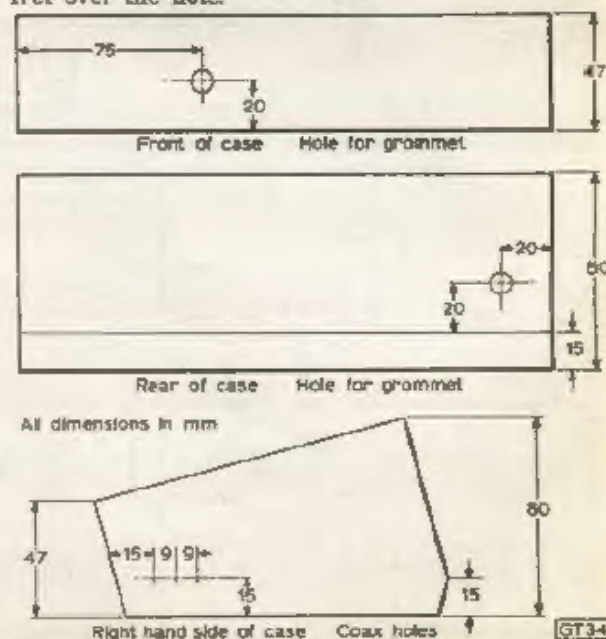


Fig. 3. Suitable drilling hole locations and sizes are shown for the box specified. The single hole in the front of the case is for both the bat control leads. It is easier to identify the bats if two holes are made, one at each end of the front.

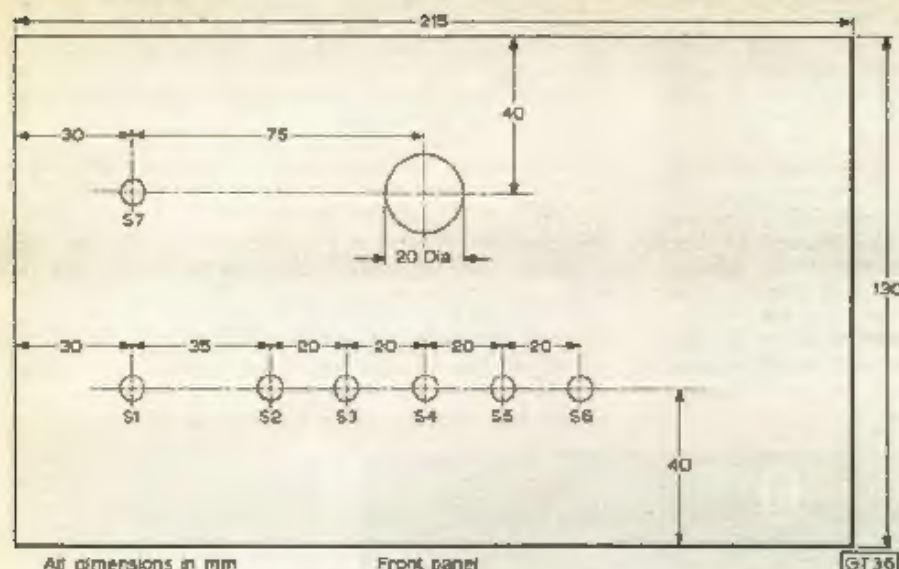


Fig. 4. The drilling details for the lid of the case specified. If a different case is used, ensure that there is sufficient depth beneath the panel for the switches.

Most of the components are mounted on a single sided PCB. Fig. 5 shows the wiring pattern and Fig. 6 the component locations. The former for L1 is stuck in position, again using rapid-cure epoxy, and when the adhesive has set, 50 turns of 40 SWG are wound onto the former. After soldering the ends as shown in Fig. 6, the screening can is fitted. It is better to wind the coil after the former is fixed to the board because although it is difficult to wind it is even more difficult to hold the winding in place whilst the epoxy sets.

The remaining components, except for the coil L2 and IC1 are mounted (not forgetting the wire link). L2 is 3 complete turns of 22 SWG tinned copper wire wound on a former so that the diameter of the coil is 6mm ($\frac{1}{4}$ inch) after the former is removed. A short length of wire is soldered to the coil $\frac{3}{4}$ of a turn from one end. The coil is mounted in position and the screen is soldered to the four pins at the

corners of the oscillator section. Leave the top of the screen off. It may be necessary to adjust the frequency. Details of the screen are given as Fig. 7.

It is strongly recommended that a socket or Solder-con pins are used for IC1. This device is of MOS construction and is liable to damage if incorrectly

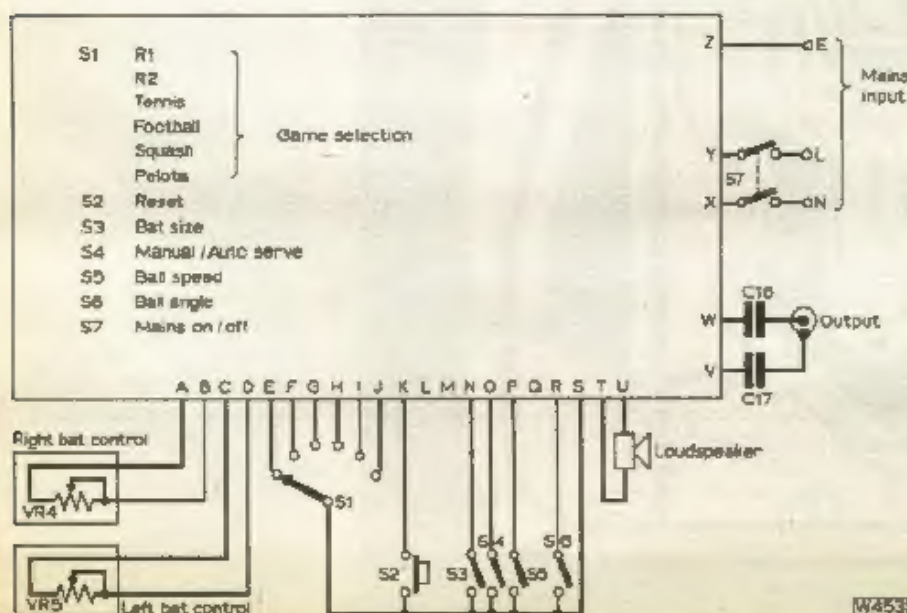
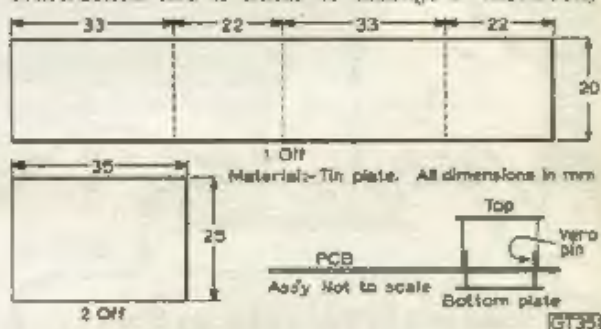


Fig. 7. Cutting and folding details for the screen required round the modulator section. Since the position of the pins is fixed the folding needs to be fairly accurate to allow for soldering.

Fig. 8. The connections from the PCB to the control are shown separately in this diagram to permit easy assembly. The same connections are shown, but not identified, on the circuit diagram (Fig. 2.)

handled. If for any reason it is necessary to solder the IC directly into the board the soldering iron must have an earthed tip and a heat shunt should be used on the pin being soldered. The socket need only be a 24 lead type since the end pins on each side are unused. If a socket is used do not insert IC1 yet.

Recheck the board for solder bridges and for good soldered joints and then mount it in the box. The dimensions given for the box specified allow for 6mm (1/4 inch) spacers beneath the board.

Connect the off-board components to the pins as shown in Fig. 8. The leads for the bat controls should be about 1 metre long and be twin cable. The variable resistors are mounted in small boxes.

Some pins on the board are not used in this 4 game unit although S1 is shown wired for all 8 games. Pins E and F can be left unwired.

A suitable length of coaxial cable needs to be terminated at both ends and a mains cable, preferably terminated with a 13A ring main plug, completes the wiring.

Now remove the IC from its protective foam and insert it into the holder.

SETTING UP

Set the core of L1 flush with the top of the former and space L2 to approximately 7.5mm long. Set VR1, VR2 and VR3 to mid position, select football on the games unit and select auto serve. Switch the unit on, push and release the reset button S2. Tones should be heard at regular intervals from the unit as the ball hits the game boundaries etc.

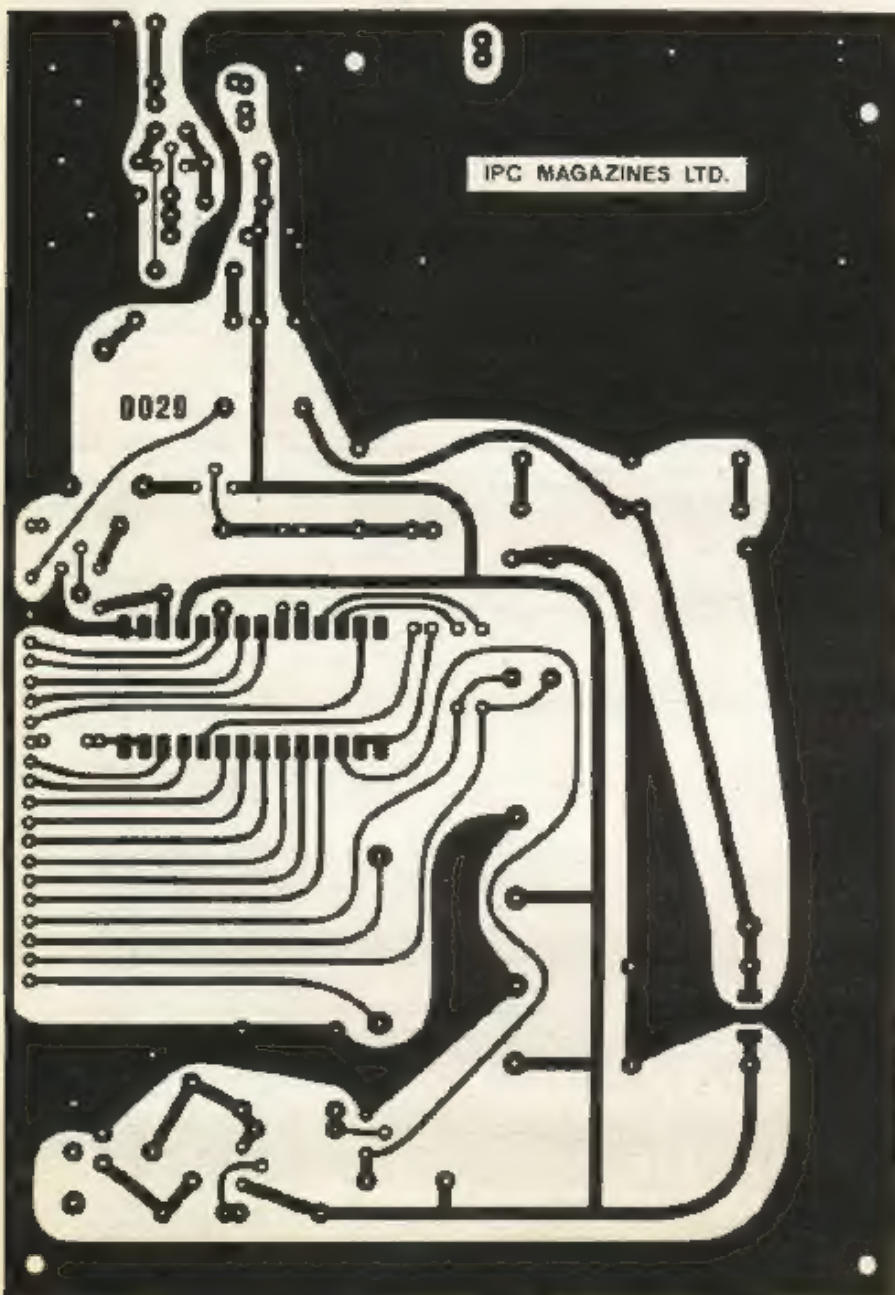


Fig.5. The wiring pattern of the printed circuit board, shown full size. For those intending to make their own boards we would stress the need for great care in laying out the IC pads and the modulator section. The earth section could be increased to conserve the etchant.

Fig.6. The component layout and orientation for the PCB. Although the outputs are not identified they conform to those shown in Fig.6. Note the tight layout of the modulator section and hence the need for careful cutting and folding of the screen.

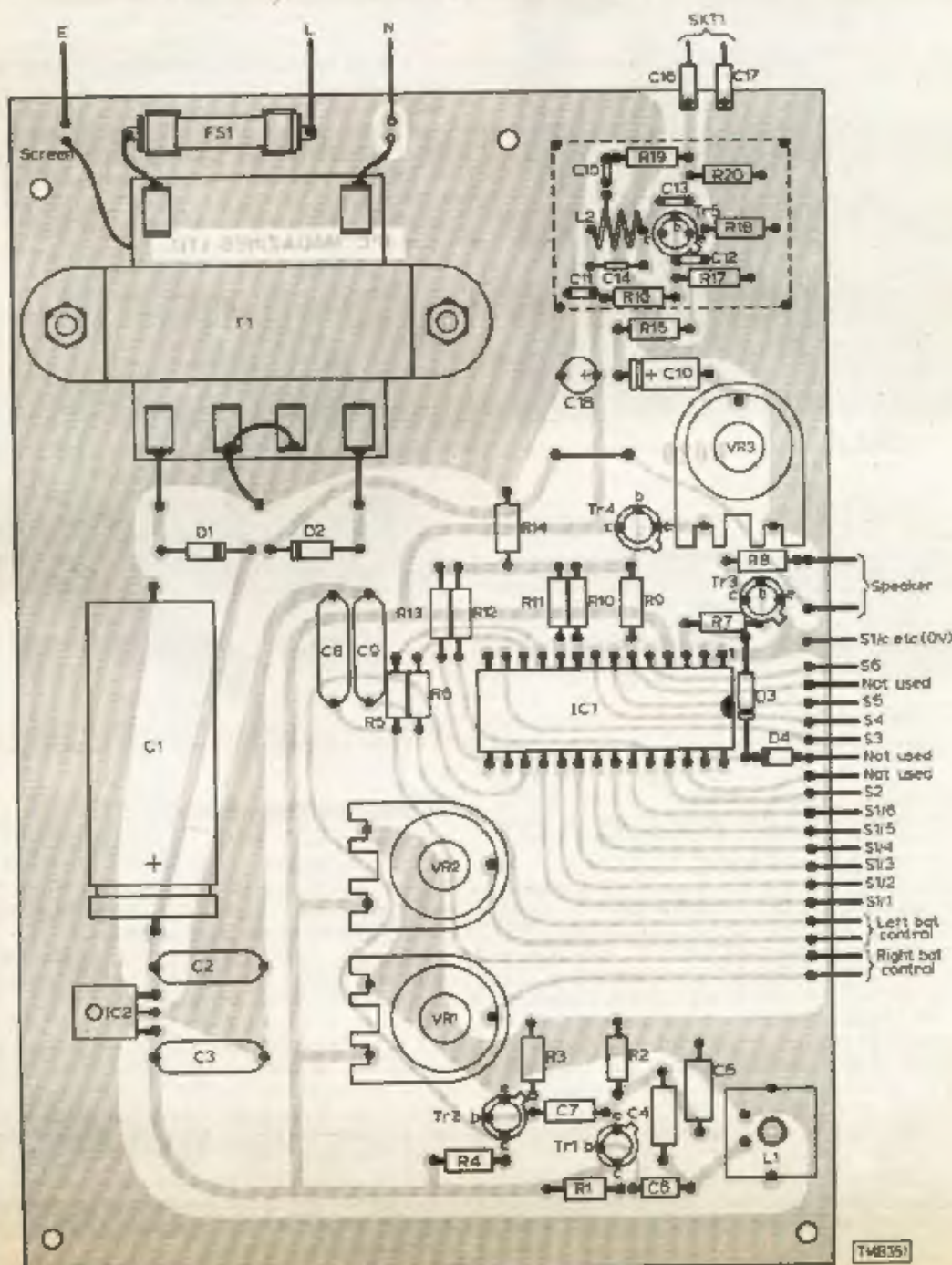
If all is well, switch the monitor on, allow it to warm up, select a spare U.H.F. channel and plug the games unit into the aerial socket. Carefully tune the viewer until the signal from the games unit appears on the screen, it may only consist of white streaks covering the screen. Slowly screw the dust core into L1 until the streaks on the screen resolve themselves into the outline of the football pitch as shown in Fig. 1. It may be necessary to re-adjust the viewer, tuning again for a good signal. Several signals will be picked up throughout the U.H.F. band, choose the best one.

When the reset button is pushed and released the football field should appear locked solid on the

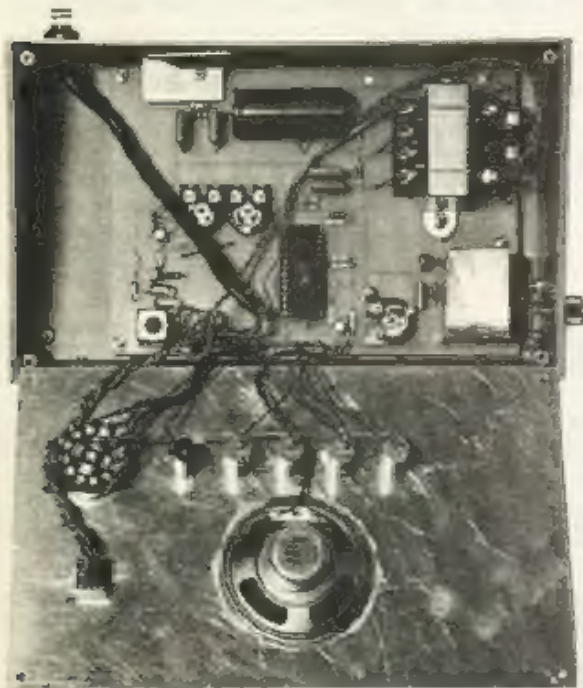
screen, if it does not adjust L1 slightly one way or the other until it locks into sync each time it is reset. When the field is stable on the screen, VR3 may be adjusted anticlockwise to increase the contrast and the brightness control on the viewer may be turned down slightly to reduce the background. (If VR3 is turned too far anticlockwise sync will be lost.)

If the signal from the unit is close to a TV station L2 may be altered in length to move the games frequency up or down the band a little, then the screening cover can be fitted.

Check that the bats sweep across the screen. VR1 and VR2 may be turned anticlockwise to reduce the



sweep of the bats but if they are turned too far the bats will disappear since the ramp will not reach the I.C. trigger level. Check the other games and the various switch functions and if it all checks out, screw the lid on the case.



A general photograph of the unit with the lid removed. The retainer for the mains cable has been removed to allow the lid to be inserted. It should be positioned to avoid too much cable inside the box when re-assembled. The short leads of the capacitors coupling the board to the output socket can be identified. These two capacitors prevent any possibility of mains being fed to the unit from the television chassis if the set has its mains reversed.

FAULT FINDING

If the unit does not work, check all wiring very carefully. Check the +8 Volts supply to the I.C., modulator and the clock generator. If an oscilloscope is available, check that the oscillator is working and producing sufficient drive for the buffer, Tr2, and is approximately 2MHz.

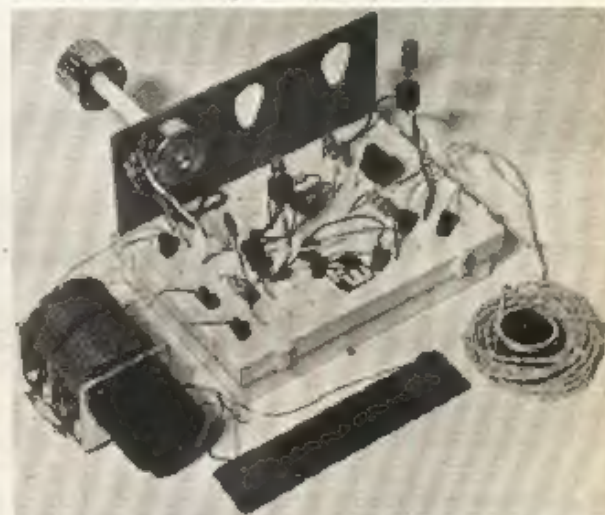
If the I.C. has +8 Volts and a good clock signal, check the sync output. This should consist of negative going pulses 4 μ S wide, at 64 μ S intervals with an approx 300 μ S frame pulse every 20 mS. If this is present, check the field and score output on pin 24, this should be a positive-going pattern repeating every 20 mS. If this is present, check that both these signals appear at the wiper of VR3. If all is well up to this point and the unit is still not working, check the modulator construction very carefully. As it is difficult to check if it is working it is possibly easiest to substitute a new transistor for Tr5.

Watford Electronics have offered to keep their special reduced price for the AY3-8500 open to readers of Practical Wireless until the end of June 1977.

S-DeCnology—continued from page 122.

of the wire, especially the tapping loop and tin these connections before soldering on some wired S-DeC plugs. If desired, the wire from the coil itself may be plugged into the S-DeC but you will still need to use some form of single core wire from the tapping point to the S-DeC because the twisted wire, being double thickness, will not easily plug into the S-DeC and may even damage it if forced. A second ferrite aerial/coil was wound on a 125mm. length of ferrite rod, 9mm in diameter and also gave good results.

The tuning capacitor used in the prototype was a twin gang 500pF + 500pF. There is no reason why a single capacitor of either 500pF or 350pF should not be used, but this will make some difference to the actual tuning scale covered by the receiver. The twin gang does give a useful opportunity for experiment. For example, with both sections connected in parallel—as shown in the circuit diagram of Fig. 1, one has a 1,000pF (or 1nF) variable tuning capacitor. By "unlinking" the two sections of VC1/VC2 to leave only one of them in circuit, one has a 500pF tuning capacitor. Again, connecting the two sections in series gives a 250pF tuning capacitor.



Rear view photograph showing the actual receiver, comprising S-DeC front mounted potentiometer, and external components.

Modification Ideas

Experimentally minded constructors may care to try altering the coil. For example, using only 24 turns tapped at 2 turns gave all sorts of 'funny' foreign stations. It may even be possible to obtain good results high up in the short wave bands.

This little receiver runs from just 3V. This is the optimum voltage. If you use a higher voltage the performance will be degraded. The current drawn by the prototype (using 3V) was 1.5mA which suggests that batteries should last for a very long time indeed. It may also be possible to run the receiver from two, small rechargeable batteries which could be kept 'topped up' from solar cells using sunlight. Perhaps the set may be happy to work directly from solar cells?

Various component changes and modifications were tried but it's left to the constructor to experiment for himself, with different component values, to obtain the best possible results.

WATFORD ELECTRONICS

(Continued from opposite side)

DIODES	BRIDGE RECTIFIERS	SCR's
AA119 15p	(Plastic Case)	Thyristors
AA121 15p	1A50V 25p	1A50V 25p
AA122 15p	1A100V 25p	1A100V 25p
AA123 15p	1A200V 25p	1A200V 25p
AA124 15p	1A400V 25p	1A400V 25p
AA125 15p	1A800V 25p	1A800V 25p
AA126 15p	2A800V 25p	2A800V 25p
AA127 15p	3A100V 25p	3A100V 25p
AA128 15p	3A200V 25p	3A200V 25p
AA129 15p	3A400V 25p	3A400V 25p
AA130 15p	3A600V 25p	3A600V 25p
AA131 15p	3A800V 25p	3A800V 25p
AA132 15p	4A100V 25p	4A100V 25p
AA133 15p	4A200V 25p	4A200V 25p
AA134 15p	4A400V 25p	4A400V 25p
AA135 15p	4A600V 25p	4A600V 25p
AA136 15p	4A800V 25p	4A800V 25p
AA137 15p	5A100V 25p	5A100V 25p
AA138 15p	5A200V 25p	5A200V 25p
AA139 15p	5A400V 25p	5A400V 25p
AA140 15p	5A600V 25p	5A600V 25p
AA141 15p	5A800V 25p	5A800V 25p
AA142 15p	6A100V 25p	6A100V 25p
AA143 15p	6A200V 25p	6A200V 25p
AA144 15p	6A400V 25p	6A400V 25p
AA145 15p	6A600V 25p	6A600V 25p
AA146 15p	6A800V 25p	6A800V 25p
AA147 15p	7A100V 25p	7A100V 25p
AA148 15p	7A200V 25p	7A200V 25p
AA149 15p	7A400V 25p	7A400V 25p
AA150 15p	7A600V 25p	7A600V 25p
AA151 15p	7A800V 25p	7A800V 25p
AA152 15p	8A100V 25p	8A100V 25p
AA153 15p	8A200V 25p	8A200V 25p
AA154 15p	8A400V 25p	8A400V 25p
AA155 15p	8A600V 25p	8A600V 25p
AA156 15p	8A800V 25p	8A800V 25p
AA157 15p	9A100V 25p	9A100V 25p
AA158 15p	9A200V 25p	9A200V 25p
AA159 15p	9A400V 25p	9A400V 25p
AA160 15p	9A600V 25p	9A600V 25p
AA161 15p	9A800V 25p	9A800V 25p
AA162 15p	10A100V 25p	10A100V 25p
AA163 15p	10A200V 25p	10A200V 25p
AA164 15p	10A400V 25p	10A400V 25p
AA165 15p	10A600V 25p	10A600V 25p
AA166 15p	10A800V 25p	10A800V 25p
AA167 15p	11A100V 25p	11A100V 25p
AA168 15p	11A200V 25p	11A200V 25p
AA169 15p	11A400V 25p	11A400V 25p
AA170 15p	11A600V 25p	11A600V 25p
AA171 15p	11A800V 25p	11A800V 25p
AA172 15p	12A100V 25p	12A100V 25p
AA173 15p	12A200V 25p	12A200V 25p
AA174 15p	12A400V 25p	12A400V 25p
AA175 15p	12A600V 25p	12A600V 25p
AA176 15p	12A800V 25p	12A800V 25p
AA177 15p	13A100V 25p	13A100V 25p
AA178 15p	13A200V 25p	13A200V 25p
AA179 15p	13A400V 25p	13A400V 25p
AA180 15p	13A600V 25p	13A600V 25p
AA181 15p	13A800V 25p	13A800V 25p
AA182 15p	14A100V 25p	14A100V 25p
AA183 15p	14A200V 25p	14A200V 25p
AA184 15p	14A400V 25p	14A400V 25p
AA185 15p	14A600V 25p	14A600V 25p
AA186 15p	14A800V 25p	14A800V 25p
AA187 15p	15A100V 25p	15A100V 25p
AA188 15p	15A200V 25p	15A200V 25p
AA189 15p	15A400V 25p	15A400V 25p
AA190 15p	15A600V 25p	15A600V 25p
AA191 15p	15A800V 25p	15A800V 25p
AA192 15p	16A100V 25p	16A100V 25p
AA193 15p	16A200V 25p	16A200V 25p
AA194 15p	16A400V 25p	16A400V 25p
AA195 15p	16A600V 25p	16A600V 25p
AA196 15p	16A800V 25p	16A800V 25p
AA197 15p	17A100V 25p	17A100V 25p
AA198 15p	17A200V 25p	17A200V 25p
AA199 15p	17A400V 25p	17A400V 25p
AA200 15p	17A600V 25p	17A600V 25p

OPTO ELECTRONICS	TRANSISTORS	VOLTAGE REGULATORS
LED's & Cds	1A400V 143p	7805 143p
7 Segment Displays	2A400V 143p	7809 143p
1220V Red	3A400V 143p	7813 143p
1221V Red	4A400V 143p	7815 143p
1222V Red	5A400V 143p	7818 143p
1223V Red	6A400V 143p	7820 143p
1224V Red	7A400V 143p	7822 143p
1225V Red	8A400V 143p	7824 143p
1226V Red	9A400V 143p	7826 143p
1227V Red	10A400V 143p	7828 143p
1228V Red	11A400V 143p	7830 143p
1229V Red	12A400V 143p	7832 143p
1230V Red	13A400V 143p	7834 143p
1231V Red	14A400V 143p	7836 143p
1232V Red	15A400V 143p	7838 143p
1233V Red	16A400V 143p	7840 143p
1234V Red	17A400V 143p	7842 143p
1235V Red	18A400V 143p	7844 143p
1236V Red	19A400V 143p	7846 143p
1237V Red	20A400V 143p	7848 143p
1238V Red	21A400V 143p	7850 143p
1239V Red	22A400V 143p	7852 143p
1240V Red	23A400V 143p	7854 143p
1241V Red	24A400V 143p	7856 143p
1242V Red	25A400V 143p	7858 143p
1243V Red	26A400V 143p	7860 143p
1244V Red	27A400V 143p	7862 143p
1245V Red	28A400V 143p	7864 143p
1246V Red	29A400V 143p	7866 143p
1247V Red	30A400V 143p	7868 143p
1248V Red	31A400V 143p	7870 143p
1249V Red	32A400V 143p	7872 143p
1250V Red	33A400V 143p	7874 143p
1251V Red	34A400V 143p	7876 143p
1252V Red	35A400V 143p	7878 143p
1253V Red	36A400V 143p	7880 143p
1254V Red	37A400V 143p	7882 143p
1255V Red	38A400V 143p	7884 143p
1256V Red	39A400V 143p	7886 143p
1257V Red	40A400V 143p	7888 143p
1258V Red	41A400V 143p	7890 143p
1259V Red	42A400V 143p	7892 143p
1260V Red	43A400V 143p	7894 143p
1261V Red	44A400V 143p	7896 143p
1262V Red	45A400V 143p	7898 143p
1263V Red	46A400V 143p	7900 143p
1264V Red	47A400V 143p	7902 143p
1265V Red	48A400V 143p	7904 143p
1266V Red	49A400V 143p	7906 143p
1267V Red	50A400V 143p	7908 143p
1268V Red	51A400V 143p	7910 143p
1269V Red	52A400V 143p	7912 143p
1270V Red	53A400V 143p	7914 143p
1271V Red	54A400V 143p	7916 143p
1272V Red	55A400V 143p	7918 143p
1273V Red	56A400V 143p	7920 143p
1274V Red	57A400V 143p	7922 143p
1275V Red	58A400V 143p	7924 143p
1276V Red	59A400V 143p	7926 143p
1277V Red	60A400V 143p	7928 143p
1278V Red	61A400V 143p	7930 143p
1279V Red	62A400V 143p	7932 143p
1280V Red	63A400V 143p	7934 143p
1281V Red	64A400V 143p	7936 143p
1282V Red	65A400V 143p	7938 143p
1283V Red	66A400V 143p	7940 143p
1284V Red	67A400V 143p	7942 143p
1285V Red	68A400V 143p	7944 143p
1286V Red	69A400V 143p	7946 143p
1287V Red	70A400V 143p	7948 143p
1288V Red	71A400V 143p	7950 143p
1289V Red	72A400V 143p	7952 143p
1290V Red	73A400V 143p	7954 143p
1291V Red	74A400V 143p	7956 143p
1292V Red	75A400V 143p	7958 143p
1293V Red	76A400V 143p	7960 143p
1294V Red	77A400V 143p	7962 143p
1295V Red	78A400V 143p	7964 143p
1296V Red	79A400V 143p	7966 143p
1297V Red	80A400V 143p	7968 143p
1298V Red	81A400V 143p	7970 143p
1299V Red	82A400V 143p	7972 143p
1300V Red	83A400V 143p	7974 143p
1301V Red	84A400V 143p	7976 143p
1302V Red	85A400V 143p	7978 143p
1303V Red	86A400V 143p	7980 143p
1304V Red	87A400V 143p	7982 143p
1305V Red	88A400V 143p	7984 143p
1306V Red	89A400V 143p	7986 143p
1307V Red	90A400V 143p	7988 143p
1308V Red	91A400V 143p	7990 143p
1309V Red	92A400V 143p	7992 143p
1310V Red	93A400V 143p	7994 143p
1311V Red	94A400V 143p	7996 143p
1312V Red	95A400V 143p	7998 143p
1313V Red	96A400V 143p	8000 143p
1314V Red	97A400V 143p	8002 143p
1315V Red	98A400V 143p	8004 143p
1316V Red	99A400V 143p	8006 143p
1317V Red	100A400V 143p	8008 143p

ALUM. BOXES with lid 84p
27x5x1 1/2" 84p
4x4x1 1/2" 84p
4x8x1 1/2" 84p
4x12x1 1/2" 84p
4x16x1 1/2" 84p
4x20x1 1/2" 84p
4x24x1 1/2" 84p
4x28x1 1/2" 84p
4x32x1 1/2" 84p
4x36x1 1/2" 84p
4x40x1 1/2" 84p
4x44x1 1/2" 84p
4x48x1 1/2" 84p
4x52x1 1/2" 84p
4x56x1 1/2" 84p
4x60x1 1/2" 84p
4x64x1 1/2" 84p
4x68x1 1/2" 84p
4x72x1 1/2" 84p
4x76x1 1/2" 84p
4x80x1 1/2" 84p
4x84x1 1/2" 84p
4x88x1 1/2" 84p
4x92x1 1/2" 84p
4x96x1 1/2" 84p
4x100x1 1/2" 84p
4x104x1 1/2" 84p
4x108x1 1/2" 84p
4x112x1 1/2" 84p
4x116x1 1/2" 84p
4x120x1 1/2" 84p
4x124x1 1/2" 84p
4x128x1 1/2" 84p
4x132x1 1/2" 84p
4x136x1 1/2" 84p
4x140x1 1/2" 84p
4x144x1 1/2" 84p
4x148x1 1/2" 84p
4x152x1 1/2" 84p
4x156x1 1/2" 84p
4x160x1 1/2" 84p
4x164x1 1/2" 84p
4x168x1 1/2" 84p
4x172x1 1/2" 84p
4x176x1 1/2" 84p
4x180x1 1/2" 84p
4x184x1 1/2" 84p
4x188x1 1/2" 84p
4x192x1 1/2" 84p
4x196x1 1/2" 84p
4x200x1 1/2" 84p
4x204x1 1/2" 84p
4x208x1 1/2" 84p
4x212x1 1/2" 84p
4x216x1 1/2" 84p
4x220x1 1/2" 84p
4x224x1 1/2" 84p
4x228x1 1/2" 84p
4x232x1 1/2" 84p
4x236x1 1/2" 84p
4x240x1 1/2" 84p
4x244x1 1/2" 84p
4x248x1 1/2" 84p
4x252x1 1/2" 84p
4x256x1 1/2" 84p
4x260x1 1/2" 84p
4x264x1 1/2" 84p
4x268x1 1/2" 84p
4x272x1 1/2" 84p
4x276x1 1/2" 84p
4x280x1 1/2" 84p
4x284x1 1/2" 84p
4x288x1 1/2" 84p
4x292x1 1/2" 84p
4x296x1 1/2" 84p
4x300x1 1/2" 84p
4x304x1 1/2" 84p
4x308x1 1/2" 84p
4x312x1 1/2" 84p
4x316x1 1/2" 84p
4x320x1 1/2" 84p
4x324x1 1/2" 84p
4x328x1 1/2" 84p
4x332x1 1/2" 84p
4x336x1 1/2" 84p
4x340x1 1/2" 84p
4x344x1 1/2" 84p
4x348x1 1/2" 84p
4x352x1 1/2" 84p
4x356x1 1/2" 84p
4x360x1 1/2" 84p
4x364x1 1/2" 84p
4x368x1 1/2" 84p
4x372x1 1/2" 84p
4x376x1 1/2" 84p
4x380x1 1/2" 84p
4x384x1 1/2" 84p
4x388x1 1/2" 84p
4x392x1 1/2" 84p
4x396x1 1/2" 84p
4x400x1 1/2" 84p
4x404x1 1/2" 84p
4x408x1 1/2" 84p
4x412x1 1/2" 84p
4x416x1 1/2" 84p
4x420x1 1/2" 84p
4x424x1 1/2" 84p
4x428x1 1/2" 84p
4x432x1 1/2" 84p
4x436x1 1/2" 84p
4x440x1 1/2" 84p
4x444x1 1/2" 84p
4x448x1 1/2" 84p
4x452x1 1/2" 84p
4x456x1 1/2" 84p
4x460x1 1/2" 84p
4x464x1 1/2" 84p
4x468x1 1/2" 84p
4x472x1 1/2" 84p
4x476x1 1/2" 84p
4x480x1 1/2" 84p
4x484x1 1/2" 84p
4x488x1 1/2" 84p
4x492x1 1/2" 84p
4x496x1 1/2" 84p
4x500x1 1/2" 84p
4x504x1 1/2" 84p
4x508x1 1/2" 84p
4x512x1 1/2" 84p
4x516x1 1/2" 84p
4x520x1 1/2" 84p
4x524x1 1/2" 84p
4x528x1 1/2" 84p
4x532x1 1/2" 84p
4x536x1 1/2" 84p
4x540x1 1/2" 84p
4x544x1 1/2" 84p
4x548x1 1/2" 84p
4x552x1 1/2" 84p
4x556x1 1/2" 84p
4x560x1 1/2" 84p
4x564x1 1/2" 84p
4x568x1 1/2" 84p
4x572x1 1/2" 84p
4x576x1 1/2" 84p
4x580x1 1/2" 84p
4x584x1 1/2" 84p
4x588x1 1/2" 84p
4x592x1 1/2" 84p
4x596x1 1/2" 84p
4x600x1 1/2" 84p
4x604x1 1/2" 84p
4x608x1 1/2" 84p
4x612x1 1/2" 84p
4x616x1 1/2" 84p
4x620x1 1/2" 84p
4x624x1 1/2" 84p
4x628x1 1/2" 84p
4x632x1 1/2" 84p
4x636x1 1/2" 84p
4x640x1 1/2" 84p
4x644x1 1/2" 84p
4x648x1 1/2" 84p
4x652x1 1/2" 84p
4x656x1 1/2" 84p
4x660x1 1/2" 84p
4x664x1 1/2" 84p
4x668x1 1/2" 84p
4x672x1 1/2" 84p
4x676x1 1/2" 84p
4x680x1 1/2" 84p
4x684x1 1/2" 84p
4x688x1 1/2" 84p
4x692x1 1/2" 84p
4x696x1 1/2" 84p
4x700x1 1/2" 84p
4x704x1 1/2" 84p
4x708x1 1/2" 84p
4x712x1 1/2" 84p
4x716x1 1/2" 84p
4x720x1 1/2" 84p
4x724x1 1/2" 84p
4x728x1 1/2" 84p
4x732x1 1/2" 84p
4x736x1